**MEMO**

To: Jim Harris (USEPA, Montana)
cc: Chris Weis (USEPA, Denver)
From: Bill Brattin (WESTON) WSB
Date: 10/2/97
Subject: Risks from PAHs in Drinking Water

Jim:

In response to our phone conversation on 10/2/97, I have calculated the estimated cancer risk to humans from ingestion of PAHs in groundwater if each of the PAHs were present at a concentration equal to the MCL. In accord with standard approaches used by EPA, the basic equation I used was:

$$Risk = C \cdot HIF \cdot oSF$$

where:

C = Concentration in water (mg/L)
HIF = Human intake factor for drinking water (L/kg-day)
oSF = Oral Slope Factor $(mg/kg\text{-}d)^{-1}$

The values I used for these input parameters are discussed below.

Concentration Term

The concentration term was assumed to be equal to the MCL.

HIF Term

Two different HIF terms were used, representing Average and Reasonable Maximum Exposure (RME) conditions. These were calculated using standard EPA default drinking water exposure factors for residents, as follows:

$$HIF = (IR/BW)(EF*ED/AT \cdot 365)$$

| Parameter | Average | RME |
|---|---|---|
| IR = Intake rate (L/day) | 1.4 | 2.0 |
| BW = Body weight (kg) | 70 | 70 |
| EF = Exposure Frequency (days/yr) | 235 | 350 |
| ED = Exposure Duration (years) | 9 | 30 |
| AT = Averaging Time (yrs) | 70 | 70 |
| HIF (L/kg-day) | 1.66E-03 | 1.17E-02 |

Slope Factor Terms

The current oral slope factor for benzo(a) pyrene (BaP) listed in IRIS is 7.7E+00 (mg/kg-day)$^{-1}$. In accord with EPA guidance, the slope factors for each of the other carcinogenic PAHs was estimated by multiplying the slope factor for BaP by the corresponding Toxicity Equivalence Factor (TEF), as shown below:

| Carcinogenic PAH | TEF (EPA 1993) | oSF (mg/kg-d)$^{-1}$ |
|---|---|---|
| Benzo(a)pyrene | 1.0 | 7.7E+00 |
| Benzo(a)anthracene | 0.1 | 7.7E-01 |
| Benzo(b)fluoranthene | 0.1 | 7.7E-01 |
| Benzo(k)fluoranthene | 0.01 | 7.7E-02 |
| Chrysene | 0.001 | 7.7E-03 |
| Dibenzo(a,h)anthracene | 1.0 | 7.7E+00 |
| Indeno(1,2,3-cd)pyrene | 0.1 | 7.7E-01 |

Source: Table 8 of USEPA 1993 (Provisional Guidance for Quantitative Risk Assessment of Polyaromatic Hydrocarbons). EPA/600/R-93/089.

Results

The resulting risk estimates for average and RME residents exposed to PAHs in water are shown in Table 1. As seen, if all of the PAHs were present in water at concentrations equal to their MCL values, estimated total excess cancer risks would range from around 7E-06 (average) to 5E-05 (RME). As may be expected based on the TEF values, most of the predicted cancer risk (87%) is due to benzo(a)pyrene and dibenzo(a,h)anthracene. It should be noted that both the average and RME risk totals are within the normally accepted risk range of 1E-04 to 1E-06 (see memo from Assisstant Administrator Don Clay, OSWER Directive 9355.0-30). Further, actual risks are likely to be lower than indicated in Table 1 since it is improbable that all PAHs will simultaneously exist at their maximum allowable concentrations.

TABLE 1 ESTIMATED CANCER RISKS TO RESIDENTS
FROM PAHs IN DRINKING WATER

| Carcinogenic PAH | MCL ug/L | Estimated Cancer Risk | |
|---|---|---|---|
| | | Average | RME |
| Benzo(a)anthracene | 0.1 | 1.3E-07 | 9.0E-07 |
| Chrysene | 0.2 | 2.5E-09 | 1.8E-08 |
| Benzo(b)fluoranthrene | 0.2 | 2.5E-07 | 1.8E-06 |
| Benzo(k)fluoranthene | 0.2 | 2.5E-08 | 1.8E-07 |
| Benzo(a)pyrene | 0.2 | 2.5E-06 | 1.8E-05 |
| Indeno(1,2,3-c,d)pyrene | 0.4 | 5.1E-07 | 3.6E-06 |
| Dibenzo(a,h)anthracene | 0.3 | 3.8E-06 | 2.7E-05 |
| TOTAL | | 7.3E-06 | 5.2E-05 |